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THE Be-In (BERYLLIUM-INDIUM) SYSTEM

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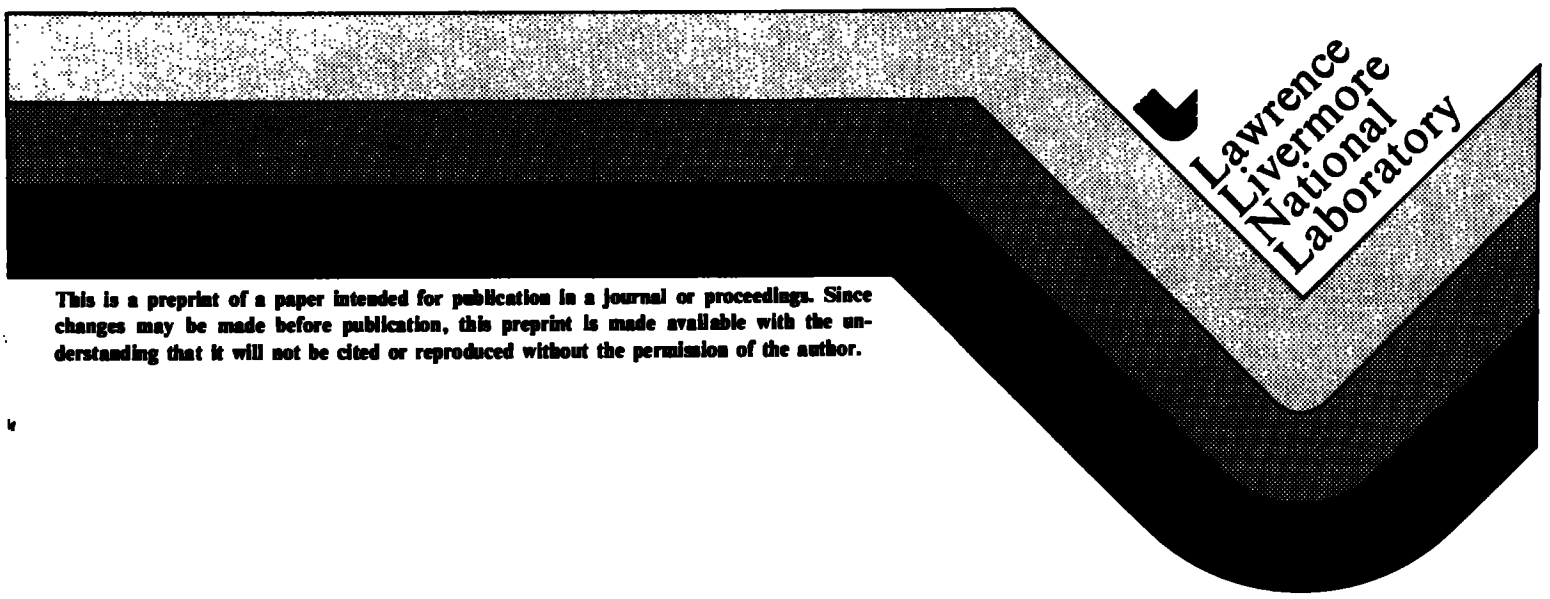

The Be-In (Beryllium-Indium) System

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Equilibrium Diagram

The assessed Be-In phase diagram (Fig. 1) is based on the work of [52E11]. There is a very wide miscibility gap within the liquid range. The monotectic temperature is believed to be very close to the melting point of Be.

(βBe) and (αBe) Terminal Solid Solutions. The melting point of βBe and the βBe —> αBe allotropic transformation temperature are 1289±4 and 1270±6 °C, respectively [85BAP]. No solubility of In in Be was found in an alloy quenched from 1000 °C according to lattice parameter measurements [52E11].

(In) Terminal Solid Solution. The melting point of In is 156.634 °C [Melt]. The solubility of Be in liquid In (Table 1) was measured by [52E11] using the sampling method.

Table 1 Solubility of Be in Liquid In (Liquidus) [52E11]

Temperature, °C	Composition, wt.%(at.%) Be
1200	0.01 (0.13)
1000	0.002 (0.025)
800	0.001 (0.013)
580	0.001 (0.013)
540	0.0007(0.009)

The Monotectic Reaction L_1 —> L_2 + (βBe). The monotectic temperature was measured by [52E11] using a 10 wt.% (0.86 at.%) In alloy.

Sample	Arrests during heating, °C	Arrests during cooling, °C
Be	1291 1280, 1294	1277, 1262 1276, 1261
0.86 at.% In	1287, 1306	1281, 1272, 1253

[52Ell] was concerned about the scatter in the observed arrest temperatures and suggested that the monotectic temperature is very close to the melting point of Be. Figure 1 is a tentative phase diagram calculated on the basis of a regular solution model (see "Thermodynamics" section). The model indicates that the monotectic point is very close to the Be-rich end of the system. The three arrest temperatures observed by [52Ell] during cooling may correspond to (1) the liquidus, (2) the $L_1 \longrightarrow L_2 + (\beta Be)$ monotectic, and (3) the $(\beta Be) \longrightarrow L + (\alpha Be)$ catatectic temperatures, respectively.

Crystal Structures

A summary of crystal structure and lattice parameter data for the pure elements is given in Table 2.

Thermodynamics

There is no experimental thermodynamic data available for the Be-In system. Only a regular solution-type model (Table 3) could be deduced from the solubility data of Be in liquid In. The lattice stability parameters of Be were derived from the heats of transformation given by [83Cha]. No solubility was assumed for the terminal phases. The monotectic point is calculated to be 0.2 at.% In and 1285.5 °C according to this model. The calculated maximum temperature of the liquid miscibility gap is 4538 °C; this is very much higher than the boiling point of either Be (2472 °C) or In (2073 °C).

Table 2 Be-In Crystal Structure and Lattice Parameter Data

Phase	Composition, at.% In	Pearson symbol	Strukturbericht designation	Space group	Prototype	Lattice parameters, nm a	c	Reference
(βBe)....	0	cI2	A2	Im3m	W	0.25515	...	[King2]
(αBe)....	0	hP2	A3	$P6_3/mmc$	Mg	0.22857	0.35839	[King1]
(In).....100		tI2	A6	I4/mmm	In	0.45990	0.49470	[King1]

Table 3 Thermodynamic Functions for the Be-In System (J/mol)

Lattice Stability Parameters:

$$\underline{G}^{o}(Be,L) = 0$$
$$\underline{G}^{o}(Be,bcc) = -12600 + 8.067\underline{T}$$
$$\underline{G}^{o}(Be,cph) = -14700 + 9.428\underline{T}$$

Excess Gibbs Energy of Mixing for the Liquid Phase:

$$\underline{G}^{ex} = 80000\underline{X}(1-\underline{X})$$

$\underline{X}$: mole fraction of In. $\underline{T}$: Temperature in K.

General References

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83Cha: M.W. Chase, "Heats of Transformation of the Elements," Bull. Alloy Phase Diagrams, 4(1), 123-124 (1983). (Thermo; Compilation)

85BAP: to be published in Bull. Alloy Phase Diagrams (1985). (Equi Diagram; Compilation)

* Indicates key paper.
# Indicates presence of a phase diagram.

Acknowledgements

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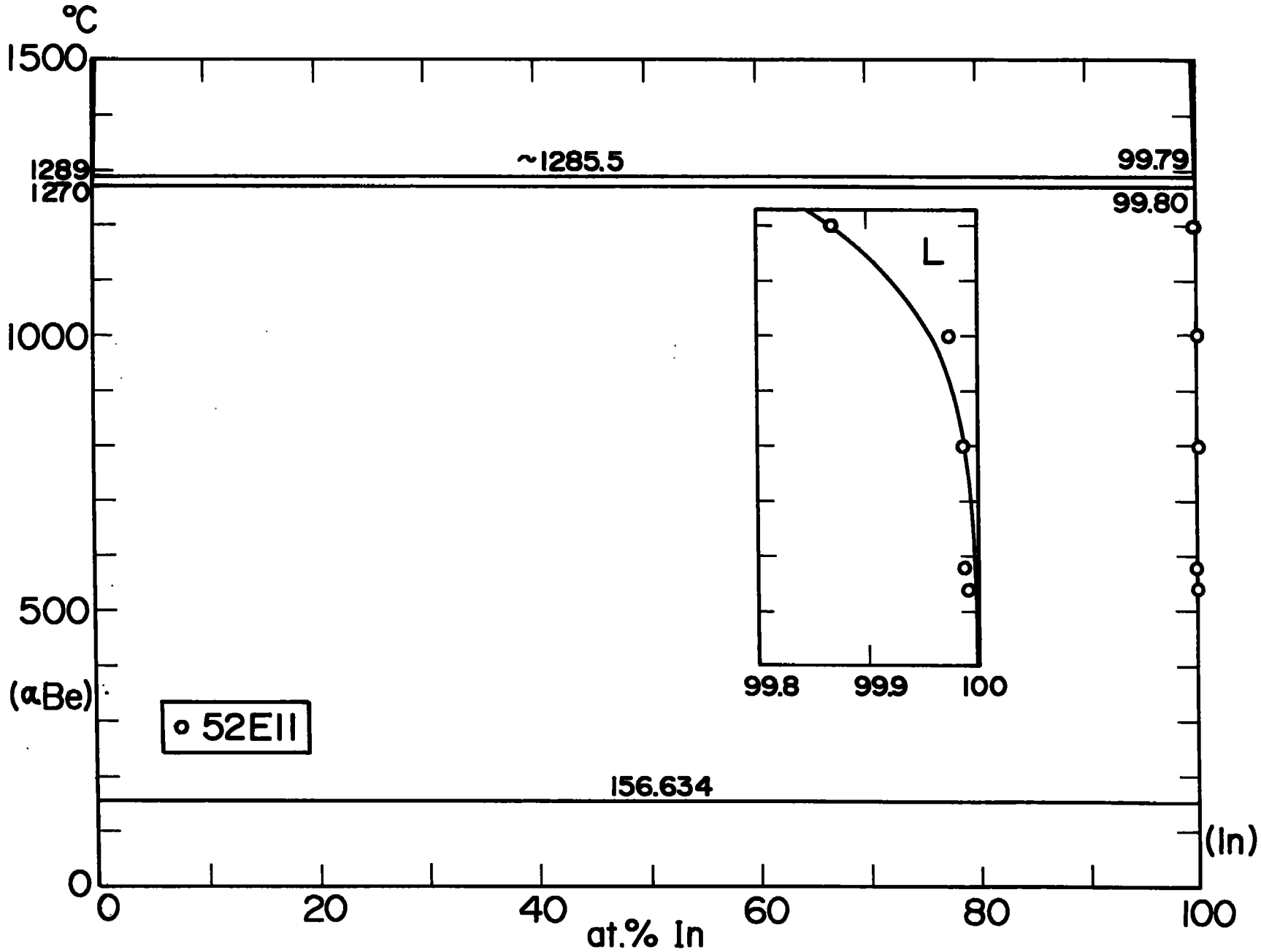
°C
1500
1289
1270
1000
500
(αBe)
0
~1285.5
99.79
99.80
L
99.8
99.9
100
o 52E11
156.634
(In)
0
20
40
60
80
100
at.% In